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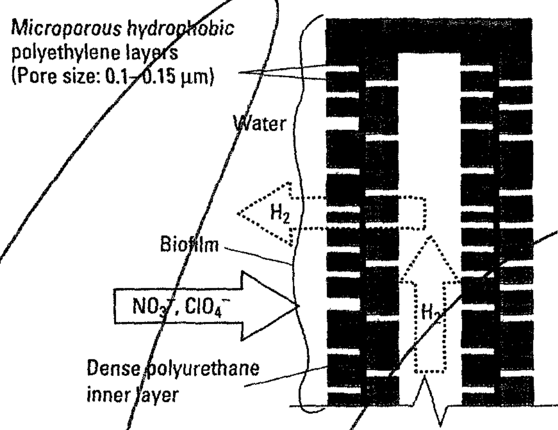
mental Engineering at Northwestern University, uses a hollow-fiber membrane biofilm reactor to reduce perchlorate to chloride through a natural biochemical process of electron transfer. The hollow-fiber membranes are essentially a bundle of long, thin straws, each around 280 micrometers in diameter. Hydrogen gas is introduced inside the membranes and diffuses across the wall to where a layer of bacteria lies in wait. The bacteria oxidize the hydrogen and reduce perchlorate in water passing along the biofilm on the outside of the membrane.

A key feature of the system is the controlled, bubbleless gas transfer of the hydrogen, which eliminates its explosion hazard, Rittmann says. "It's particularly advantageous because the hydrogen diffuses through the membrane wall on an on-demand basis," with the microbes themselves determining how much hydrogen moves through. Moreover, hydrogen makes for an ideal electron donor because it is nontoxic, doesn't persist in water, and is by far the least expensive bulk source of electrons, Rittmann adds.

In an ongoing pilot study of a contaminated well in La Puenta, Calif., the reactor lowered perchlorate levels from 60 micrograms/liter (μg/L) to below the detection limit of 4 μg/L, which is the current action limit of California's Department of Health Services, says Samer Adham of Montgomery Watson Harza, the environmental engineering firm testing the technology. A very preliminary cost estimate for the process comes out around

Hollow-fiber membrane

Perchlorate reduction occurs in the biofilm growing on the outer of two porous polyethylene layers.



Source: Montgomery Watson Harza and Northwestern University

$0.50/1000 gallons for full treatment with a flow capacity of 2500 gallons per minute, according to Rittmann.

The membrane process comprises one of four technologies that look to be the most feasible for removing perchlorate from drinking water supplies, says Traci Case of the AWWA's Research Foundation. The others include an ion-exchange system, a granular activated carbon system, and a packed acetate bed bioreactor, also a biological treatment process (*Environ. Sci. Technol.* **2001**, *35*, 482A–487A).

A disadvantage of the two nonbiological processes is that they don't actually destroy the perchlorate, Adham says. They remove perchlorate by adsorbing it to various media, but the resulting concentrated brine creates difficult disposal problems. That's why biological systems look so promising, he notes.

In the past, regulators have expressed reservations about using biological treatments for drinking water (*Environ. Sci. Technol.* **1999**, *33*, 515A). However, this system, says Case, has an advantage because "the hydrogen is separated by the membrane from the water being treated, and the biofilm is on the membrane surface, which will hopefully make it look more attractive to regulators." The technology can also simultaneously reduce nitrate and could remediate other water contaminants, such as bromate, selenate, chlorinated solvents, explosives, and metals.
—KRIS CHRISTEN

Prioritizing drinking water contaminants

In response to recommendations from the U.S. National Research Council (NRC), the U.S. EPA is revising its approach for identifying emerging contaminants of concern. Ultimately, the course chosen will define the future of the drinking water program, said EPA's Ephraim King at the American Water Works Association's (AWWA) annual conference in June.

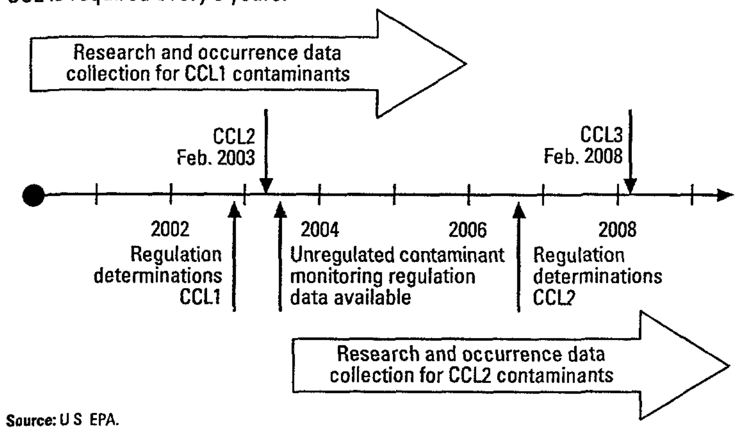
As required by the 1996 Safe Drinking Water Act (SDWA) amendments, EPA published its first list of unregulated contaminants of concern in 1998, which is known as the Contaminant Candidate List (CCL). This CCL was pared down from an initial list of 400 contaminants to 50 chemical and 10 microbial contaminants and helped EPA prioritize its research and monitoring programs, as well as set its regulatory agenda.

Because of the short timeframe for developing this first CCL, EPA had to rely primarily on expert opinion, says Tom Carpenter, an environmental protection specialist in the agency's Office of Ground Water and Drinking Water. For future CCLs, which are required every five years under the SDWA, EPA is working to develop a more quantitative approach in identifying candidates that is heavily based on recommendations from an NRC report (*Environ. Sci. Technol.* **2002**, *36*, 18A).

These recommendations include screening a universe of some 10,000–100,000 chemicals in commercial use, as opposed to only the few that normally receive attention. Following this initial screen, the NRC recommends determining health effects and studying occurrence for such factors as severity,

Contaminant Candidate List (CCL) timeline

The U.S. EPA will decide whether or not to regulate drinking water contaminants on its CCL1 by the end of this year, before issuing the CCL2 in February. A new CCL is required every 5 years.



Source: U S EPA.

potency, prevalence, magnitude, persistence, and mobility to ferret out those contaminants of concern. These data would then be classified and prioritized using powerful statistical tools such as neural networks.

To help develop the methodology for sorting through all these contaminants, EPA is convening an advisory working group made up of stakeholders, including public water utility representatives, environmental and public interest groups, state regulatory agencies, and public health offices.

The group is expected to meet for the first time this fall, and it faces a daunting task. The amount of health effects and occurrence data on many of these contaminants is slim, as are appropriate analytical methods for detecting them at low concentrations in water, says Steve Via, a regulatory engineer with AWWA. Consequently, developing an appropriate screen will be difficult, and the working group's efforts will likely come too late to be incorporated into the CCL2 due out in February.

Carpenter acknowledges as much, but says the agency may put out an interim list using any new information gleaned through the stakeholder process before the CCL3 comes out in 2008. If data gaps are filled before the next review, EPA will move forward with a regulatory determination, Carpenter says. For example, EPA is likely to pursue regulations for metolachlor by the end of this year and expects to make a ruling on MTBE and perchlorate as soon as it obtains the necessary occurrence data, which are expected by the end of 2003, he says.

In the meantime, environmentalists worry that EPA won't be issuing new regulations for any drinking water contaminants. "We're concerned that they're dropping the ball on all the contaminants already on their list by not moving forward with controls on those," says Erik Olson, a senior attorney with the Natural Resources Defense Council. He was referring to a June 3rd *Federal Register* notice in which EPA announced a preliminary determination that "regulatory action is not appropriate or necessary" for nine of the contaminants on the current CCL. The data that EPA considers in its assessment include projected adverse health effects, extent of contaminant occurrence, and whether a regulation would likely result in a reduction of health risk. EPA found that it has "insufficient information to support a regulatory determination" on the other 51 contaminants, and so has not issued regulations for any of the CCL1 contaminants. —KRIS CHRISTEN

Government Watch

EU ban covers pesticides

In July 2003, the European Commission will ban 320 active substances used in plant protection products (PPPs), including insecticides, fungicides, and herbicides, in its drive to harmonize safety standards of PPPs throughout the EU. By mid-2003, the Commission expects to have withdrawn up to 490 active substances, more than 60% of what was available in 1991.

The move follows a 1991 directive to set up an EU-wide approval process for active substances in PPPs. The directive requires manufacturers to prove that their products meet required safety standards before EU authorization. Manufacturers chose not to defend these 320 substances.

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In June, the Commission gave industry advance warning of withdrawal of another 200 substances. It anticipates that industry won't defend about 150, which would be withdrawn in July 2003.

Companies chose not to defend substances primarily for economic reasons, including the high cost of developing a case defending the safety of the substance, says Kari Matalone of the European Crop Protection Association. Several products were already being phased out or no longer sold in Europe.

However, some substances that were undefended because of limited market potential in Europe may have important markets outside the EU—for example, those used with sugarcane, tropical fruits, and tobacco—and this could lead to potential problems in international trade.

By mid-July, the Commission had considered 62 defenses of active substances. It ruled that 38 of the substances have safe uses and 24 do not.